The Giovanni News
May 2014
GODDARD EARTH SCIENCES DATA & INFORMATION SERVICES CENTER (GES DISC)

From the Editors

Precipitation is one of the most important variables in Earth's climate system, and it is also one of the most important variables for humans. The primary determining factor of a region's characteristic environment is its normal or average amount of precipitation, ranging from the nearly constant mist and rain in a rain forest to the arid conditions of a desert. The normal amount of rainfall a region receives is a major factor for human habitability. We humans have devised clever ways to divert or store freshwater, making it possible to live in many otherwise inhospitable areas.

In this issue, we look at several different aspects of precipitation with Giovanni. The research highlight is a presentation at a recent meeting on lightning detection and lightning meteorology, which examined the connection between lightning and nitrogen dioxide (NO_2) concentrations, because the heat of a lightning bolt makes NO_2 naturally in the atmosphere. On the subject of *too much* precipitation, we'll examine the recent deluge in Pensacola, Florida. And, on the subject of *too little* precipitation, we'll see what we can learn about the snowpack in the Sierra Nevada Mountains of California. We also have a short update on Giovanni-4 development.

We hope it's sunny wherever you are – but we hope you get the right amount of rain, too.

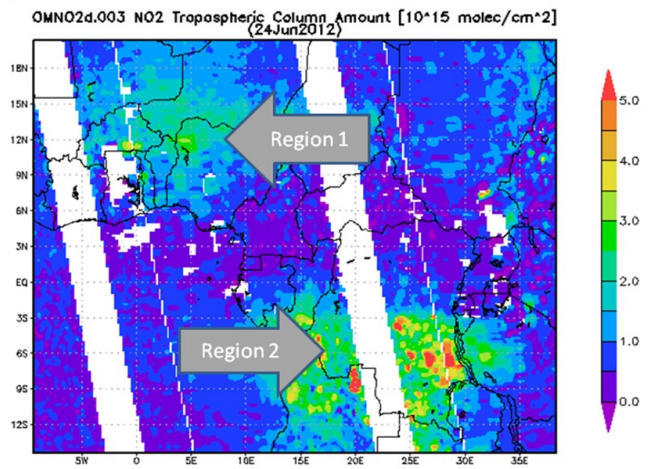
Regards,
Jim Acker and Wainie Youn, Editors

Research Highlight: Analysis of Ground Network Lightning Data Relative to OTD/LIS to Derive Flash Rates for Use in Determining Lightning NO_x Production from Satellite Observation

Presented at the 23rd International Lightning Detection Conference and 5th International Lightning Meteorology Conference, Tucson, AZ, March 18-21, 2014
D.J. Allen*, A. Ring*, K. Pickering**, A. Nag+, R. Holle+, and R. Holzworth§ * University of Maryland, College Park ** NASA-GSFC, Code 613.3 + Thunderstorm Systems and Data, Vaisala Inc. § University of Washington

The goals of this study were to (1) compare lightning detection rates from space-based sensors and ground-based networks and (2) examine a storm complex over western Africa to determine if lightning-generated nitrogen dioxide (NO_2) could be detected by the Ozone Measuring Instrument (OMI) on the Aqua satellite. The authors described how they compared lightning detection efficiencies (DE) of the World Wide Lightning Location Network (WWLLN) and Vaisala GLD360 to the lightning DE of the Optical Transient Detector (OTD) on the MicroLab-1 satellite and the Lightning Imaging Sensor (LIS) on the Tropical Rainfall Measuring Mission (TRMM) satellite. The aim was to determine the total number of lightning flashes contributing to the formation of nitric oxide (NO) and NO_2 in association with storms. They analyzed two different time periods for the two ground-based networks and, then, gridded the results globally for WWLLN and regionally (central Africa) for GLD360. According to the authors, lightning DE for this particular area by the ground-based networks is low compared with much of the rest of the world.

Following this analysis, the researchers generated two flash rate maps for an area of storminess that occurred over western Africa on June 24, 2012. Based on the estimated DEs, the authors estimate that over 90,000 lightning flashes (4.4 - 4.5 flashes per second) occurred in this area in a six-hour period.



Giovanni was used to generate the above map of OMI NO_2 Column Amount for the same region and time period (June 24, 2012) examined in Allen et al. Region 1 is the area of elevated NO_2 corresponding to the area of high lightning flash detection. Region 2 is the area of elevated NO_2 corresponding to the area of elevated MODIS AOD, most likely due to biomass burning. Based on this case study, in the absence of other factors that cause elevated NO_2, it appears possible to detect NO_2 generated by the high lightning flash rates found in thunderstorms.

Giovanni was used to examine both the NO_2 data from OMI for this period and aerosol optical depth (AOD) from MODIS, to see if AOD indicated other potential sources of NO_2, such as biomass burning or other human activities. MODIS AOD was elevated over central Africa but was not particularly high over western Africa. The authors noted both the apparent association of NO_2 with lightning for the area of storminess in western Africa and the association of elevated AOD and NO_2 in central Africa. These associations indicate that other sources of NO_2 must be evaluated when attempting to estimate the NO_2 production rate in the atmosphere by lightning.

In this Issue

April Rain in the Florida Panhandle: Floods and Records

Here are some excerpts from articles found on the Web about the massive rainfall event that occurred in late April, centered on Pensacola, Florida. This brief but incredibly intense event caused heavy flooding around the city, in some cases temporarily turning neighborhoods into islands, and made it difficult to determine where the Gulf of Mexico ended and Florida began. Road damage was widespread and the lives of many residents were disrupted.

Storms Dump Record Rainfall in Pensacola (NBCMiami.com)

"One Pensacola weather station recorded 17.7 inches of rain between Monday [April 28] morning and Wednesday [April 30] at 7:40 a.m., the National Weather Service reported. At the Pensacola airport, 15.55 inches of rain fell on just Tuesday [April 29], from midnight to midnight, setting a record for the rainiest single day in the city. It was so rainy the automated rain gauge failed. The 17.7-inch mark is from another spot in the city. Some estimates of the drenching storm's rain totals go as high as 22 inches."

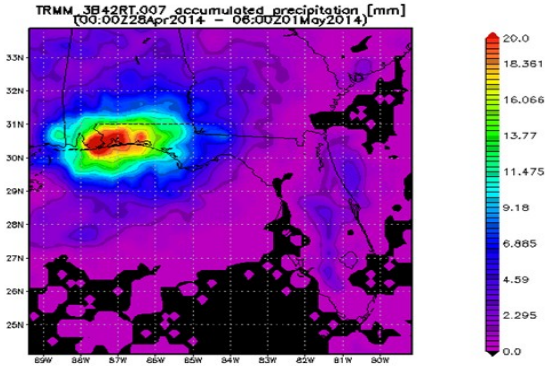
The Calamitous Climate Responsible for Florida's Record Rainfall (Slate.com)

"The National Weather Service called the event "historic." The official rain gauge at Pensacola's airport measured an astonishing 5.68 inches in a single hour before it failed around 10 p.m. Tuesday. An analysis by the NWS office in Mobile, Alabama, estimated that single hour to be a 1-in-200- to 1-in-500-year event."

Record-Setting Rain Ravages Southern and Eastern Coasts (TIME.com)

"The NWS said up to 18.9 inches of rain fell over a 24-hour period in Alabama and Florida, CNN reports. The airport in Pensacola, Florida recorded 15.55 inches of rain, the highest rainfall total in a single calendar day since the NWS began tracking rainfall totals in 1880."

The Tropical Rainfall Measuring Mission (TRMM) Multi-satellite Precipitation Analysis data product, which is available in near-real-time (TMPA-RT), was used by Giovanni to generate a map of accumulated rainfall for this event. Note that the average accumulation over an area in TMPA is typically lower than what is measured by individual rain gauges at weather stations within the same area. The following map demonstrates the localized intensity of rainfall on the far western end of the Florida Panhandle. The time period used to generate the map was 00Z on April 28 to 06Z on May 1.



Excerpts from the Release Notes for Giovanni-4, Version 4.7

New in Giovanni 4.7

Variables with non-global geographic coverage can now be visualized

Regarding the New User Interface:

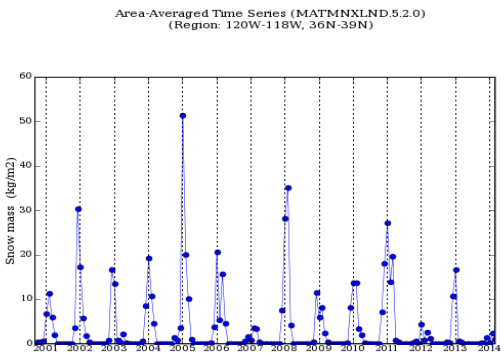
The User Interface is being redesigned to be less opaque to new and occasional users. It also allows users to narrow down variables for selection, either by selecting particular attributes ("faceted browsing") or filtering by keywords. However, experienced Giovanni users may see some "user interface shift shock." In some cases, certain things may seem more difficult or tedious to do than in Giovanni 3. Please tell us those things (using the Feedback button), with particular reference to how you used to do them in Giovanni 3! We may also be able to provide some short cuts (e.g., Bookmarkable URLs.).

Sierra Nevada Snowpack: What's 'Normal'?

On the West Coast of the United States, as well as for several states in the U.S. Southwest, the increasing severity of drought is a major concern. Both rain and snow have been far below normal, causing reservoirs to diminish and natural mountain snowpack to shrink. Many of these states rely on runoff from mountain snowpack to be a significant part of their water resources.

As this article is written, the entire state of California is at some level of drought, according to the United States Geological Survey. One of the main indicators of the drought, which was the subject of a recent Image of the Day on NASA's Earth Observatory, is the snowpack in the Sierra Nevada Mountains ("All Dry on the Western Front," January 23, 2014, http://earthobservatory.nasa.gov/IOTD/view.php?id=82910). In that article, a comparison of Moderate Resolution Imaging Spectroradiometer (MODIS) images from January 2013 and January 2014 provides strong visual evidence that the snowpack in the Sierras is currently at a very low level.

The two MODIS images, however, only show a comparison for two successive years. The ***Snow Mass*** data product from the Modern Era Retrospective-analysis for Research and Applications (MERRA) Project allows the creation of a time-series of snow mass for the last several years, from September 2000 to March 2014 (the last month for which data were available). The accompanying image shows the area that was used to calculate the time-series. Mono Lake, the round lake just to the east of the snowpack near the center of the rectangular area, provides a visual reference point.



This time-series indicates that, in terms of snowfall, the Sierra snowpack definitely has good years and very bad years. With the exception of 2007, 2012, and most recently 2014, most of the years have had a relatively consistent amount of snowfall. (Skiers were probably very happy in 2005 and 2008!) It appears from this time-series that California's water shortages stem from the very low snowfall year in 2012, followed by a roughly average year in 2013. The situation worsened considerably, due to the small amount of snow that fell over the past winter. Still, if Californians can make it through a hot and dry summer in 2014, the possible El Niño that is now being forecast could provide a much-needed boost to the Sierra snowpack. Of course, El Niño can also bring high winds, storms, coastal erosion, landslides, flash flooding, and tropical marine organisms invading the offshore waters. The surfing should be gnarly, though.